THE FOOD CHAIN

Introduction

The food chain is best described as an intricate set of relationships that help ecosystems function. A complete ecosystem consists of members from all parts of the food chain, where something always eats something else, and nutrients are recycled back into the soil. The food chain is part of the first law of thermodynamics, which states that matter is neither created nor destroyed. All nutrients, chemicals, etc. are recycled in some way on the earth. All energy has to go somewhere and the members of the food chain make that possible. The basic members of the food chain are: producers, herbivores, omnivores, carnivores, and decomposers.

The food chain always goes through a complete cycle, but the best place to begin discussing the cycle is with producers. A **producer** is any organism that takes energy from the sun, carbon dioxide, and water to produce sugars (a.k.a. energy). This process is known as **photosynthesis**. Producers consist of plants, cyanobacteria, algae, seaweed, and **unicellular** photosynthetic organisms. We will focus primarily on plants for these exercises. Plants have special structures in their cells called **chloroplasts** which produce sugars. In turn, those sugars are then eaten by a **consumer** and go through the reverse process called **respiration**. Photosynthesis and respiration are the processes by which organisms burn compounds to produce energy, but there are many other complex equations for the way other nutrients are recycled. Nitrogen is required to build proteins, and phosphorous is required in order for DNA to replicate. These processes will not be described in this curriculum. The equations below are for instructor reference only.

Photosynthesis: $6CO_2 + 6H_20 \xrightarrow{\text{sun}} C_6H_{12}O_6 + 6O_2$

Carbon dioxide + water → Glucose (sugar) + oxygen

Respiration: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_20$

Glucose (sugar) + oxygen → carbon dioxide + water

Consumers consist of all other organisms that don't produce energy from the sun. Within the consumers, there are: herbivores, carnivores, omnivores, and decomposers.

Herbivores are animals and organisms that eat only plants, or producers. Herbivores are most notably recognized in the mammalian class with animals such as: deer, squirrels, chipmunks, cows, antelope, and horses. Rodents are most often herbivores, deriving their food from nuts and fruit. Ungulates (hooved animals) eat grasses and flowers, and sometimes leaves and braches from trees. The ungulates have very recognizable, flat teeth for crushing plant matter, as well as highly complex digestive systems for breaking down cellulose (or roughage). Other herbivores include many insects, some reptiles, and some birds. Many herbivores are **specialists**, eating only one specific plant or maybe just a few types of plants.

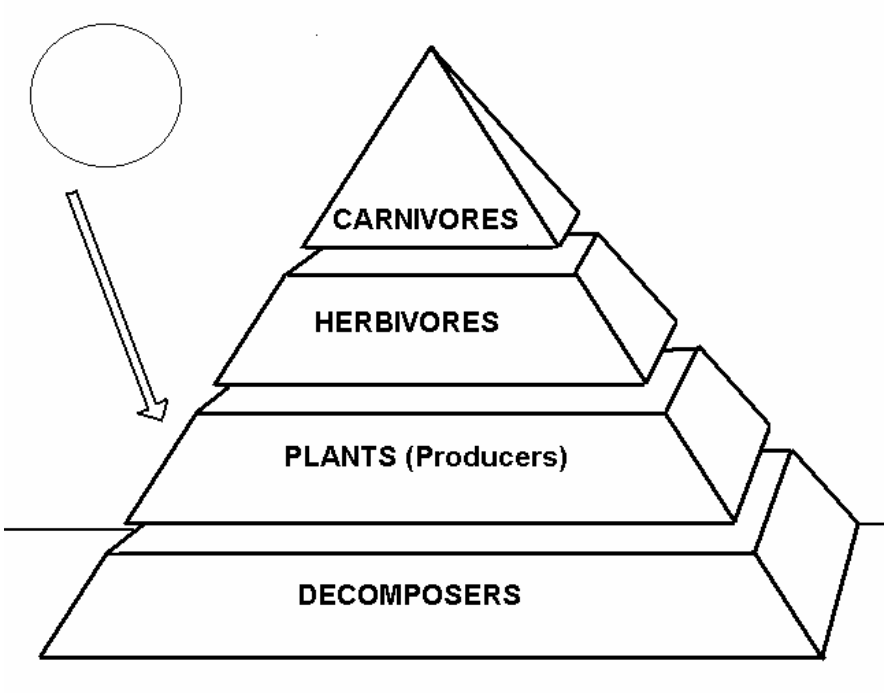
The most easily recognized **carnivores** are animals like wolves, foxes, lions, tigers, raptors (birds of prey), sharks, seals, and sea lions. These members of the food chain are extremely important because they keep other animal populations in check. Without carnivores, there would be too many herbivores on the earth, and many would die of starvation because there wouldn't be enough plants to support them. It is important to help the class recognize that while some animals are easy to recognize as carnivores, others aren't. Anything that eats another animal is a carnivore, even if they are just eating insects or worms. Things like frogs, salmon, and spiders are carnivores. The term **predator** is a more finite term which

defines an animal that hunts and kills its prey, like cats, wolves, and raptors do. Carnivores are often recognized by having with sharp teeth and claws.

An **omnivore** is an animal that eats both plants and animals. Omnivores have a combination of teeth shapes: **molars** for crushing plants**, canines** for tearing flesh, and **incisors** for initial cutting. Omnivores include animals such as bears, apes, and humans. Many omnivores are **generalists**, meaning they can eat a wide variety of things.

Decomposers consist of a wide variety of organisms, most of which we cannot see. A decomposer is something that feeds on dead plant or animal matter. **Bacteria** are very important decomposers and the students should understand that most bacteria are not bad. Explain an example they can relate to everyday: Yogurt is made using special bacteria that give milk a unique taste. Yogurt is really just milk being decomposed by bacteria, but that bacteria isn't harmful to us. Another set of decomposers are the fungi. **Fungi** are organisms such as mushrooms, yeast, and mold. When you are walking in a forest, you often see mushrooms growing on the ground or on a fallen log. Those mushrooms eat away at the dead matter, and help recycle nutrients back to the soil. Animals can also be decomposers. Worms in the soil help decompose, as well as banana slugs and some insects. Even **scavengers**, such as vultures, could be looked at as decomposers, because they eat dead animals. Help students understand that the word decompose is synonymous to **decay** and **rot**. Decomposition is the final phase in the food/nutrient cycle because it takes dead matter and makes it useful again.

Following is a detailed description of supplementary activities that can be done with students to help them learn about the food chain. Be sure to emphasize that every living thing has an important role in the food chain, and ultimately, nothing is wasted.



FOOD CHAIN ACTIVITIES

Objectives:

By using examples of plants and animals at Muir Woods, these activities are to provide students with the understanding that every living thing has a place in a nutrient cycle known as the food chain, or food web. We will also use examples that help the children relate to their own lives.

Goals:

1. Students will be able to identify where their food comes from.
2. Students will understand the differences between carnivores, herbivores, omnivores, producers, and decomposers, and be able to place them in their appropriate places on a diagram. They will also understand what the difference is in a generalist and a specialist.
3. Students will know that plants are the primary source of energy in most food chains.
4. Students will know how to identify an organism's place on the food chain by looking at basic structures on the plant, fungus, or animal (like teeth, claws, plant parts).
5. Students should understand that bacteria and other microorganisms are present and have important roles in the food chain.
6. Students will understand that everything stays here in some form.
7. Students know that animals and plants must compete for resources.

This set of activities conforms to the following California grade standards, and can be adapted for a variety of ages:

First Grade:

1. Plants and animals need water, food and light.
2. Plants and animals are eaten by animals.
3. Animal teeth are shaped differently for different foods.

Fourth Grade:

1. Plants are the primary source of energy in most food chains.
2. Students learn the different members of the food chain.
3. Nutrients move in a cycle called the food chain or food web.
4. Animals and plants compete for resources.

Fifth Grade:

1. Plants and animals are responsible for the exchange of oxygen and carbon dioxide.
2. Animals break down sugar for energy.
3. Plants create sugar and oxygen

Sixth Grade:

1. The term photosynthesis is used.

The activities can be done all at one time, or on separate days. This is at least a day's worth of activities, and involves a lot of art, so it is recommended that they are divided into more than one day.

LESSON ONE: Is it plant or animal?

Objective: Help students understand that their food always begins as a plant or animal (or fungus if you wish to include that).

Materials: Food items, butcher paper (or large sheets of paper), markers

1. Divide class into 5 or 6 groups.
2. Provide each group with one of the following (also provide the "nutrition facts" from the packaging):
    - Crackers (packaged)
    - a can of tuna
    - a carton of milk
    - a candy bar
    - a can of tomato soup
    - a spice (like cinnamon)

    * You may use other food items if you wish
3. Provide each group with a piece of butcher paper and bold markers.
4. Have one student draw a large picture of their food item on the butcher paper, and write what the item is.
5. Allow the students to brainstorm where their food item came from: a plant, an animal, or both. Encourage them to look at the ingredients on the "nutrition facts". Help them understand where different food ingredients are from (e.g. sugar is a plant, milk and butter are from animals). Have them write their answers on the butcher paper. They can list each ingredient and where it came from, especially on the food items where certain ingredients may be from a plant and some from an animal (e.g. crackers: butter is from an animal, and flour is from a plant).
6. Have the groups present their ideas to the class, and display their work in the classroom.

LESSON TWO: What do your teeth look like?

Objective: Tooth shape is a way of knowing where an animal belongs on a food chain.

Materials: Pictures of different tooth types, mirrors, paper, and pencils

1. With their groups, have the children look at their teeth in a mirror.
2. Allow them to discuss what their teeth look like, and if they notice that their teeth are different shapes. Have them draw the different shapes and label the different types.
3. Ask the class what they think the different tooth shapes are for, and if they are used to eat plants or animals.
    - Incisors (front teeth) are for cutting. (herbivores)
    - Canines (sharp teeth) are for ripping flesh (carnivores)
    - Molars (flat teeth in back) are for crushing and mashing. (herbivores)
4. Explain that different tooth shapes have different purposes, and humans have all kinds because they eat plants and animals.
5. Show them pictures of teeth, or draw them on the chalkboard, from an herbivore and teeth from a carnivore.
6. Have the groups name 5-6 animals and have them identify what type of teeth they might have. If you have old magazines available, the students can look for pictures of animals to use.

LESSON THREE: Where do I belong on the food chain?

Objectives: To understand the members of the food chain and where they fit into the cycle.

Materials: Food chain vocabulary list and food cycle copied for each student, pencils or markers, old magazines with nature themes, tape or glue, scissors.

1. Pass out vocabulary lists and food cycle diagrams.
2. Using the vocabulary list, students fill in the food cycle diagram. It may be helpful if you write the five words on the board. After they fill out the diagrams, discuss the vocabulary list with them. Ask them if they can think of other examples in addition to the ones listed on the vocabulary list.
3. Let students cut out pictures of plants, animals and decomposers and glue them on their diagram in the appropriate places, drawing arrows from the organism to their title (e.g. picture of bear → carnivore).
4. Display their work in the classroom if desired.

LESSON FOUR: Let's go hunting!

Objectives: To help students understand that resources are limited, and some animals may be able to get more food than others. Students will understand that some animals are generalists, meaning that they can eat more types of food, so they will have an easier time finding food. They will also understand that the opposite of a generalist is a specialist, or an animal that only eats one or very few types of food.

Materials: Plant and animal cards, tape or sticky-tac
* This activity will take about 30-60 minutes of preparation time.
* It is advised that you share the activity with other teachers, so the cards don't go to waste afterward.

Teacher will do the following to prepare for this activity:
1. Print out the plant and animal cards, preferably on cardstock, and cut out the individual cards. Separate the larger cards into a different pile.
2. Paste the smaller cards, randomly, around the classroom or game area. You can choose to place them on furniture, the walls, or both, but make them visible, so the majority of cards are found.

For the game:
1. Pass each student one of the larger cards (e.g. SPOTTED OWL loves to eat…). There are 35 of these cards. If you have less students than this, eliminate one of each type of animal until you have the appropriate number of cards to match the number of students you have. (e.g. don't get rid of all the mule deer or all the raccoons.) Keeping the animals in the right proportions is very important for this activity.
2. Tell them to look at their card, and explain that they will be that animal. Give them enough time to read and understand what they love to eat.
3. Tell them that they have to go hunting for their food. When you say GO!, they have to go around the classroom as fast as they can and find food (the smaller cards which are pasted around the room), but **they can only take the cards of the food that their particular animal can eat**. (e.g. if the student is a chipmunk, they can only take cards that say "bay laurel" and "tanoak"). Let them hunt until it looks like no one else is finding any food…about 5 minutes.

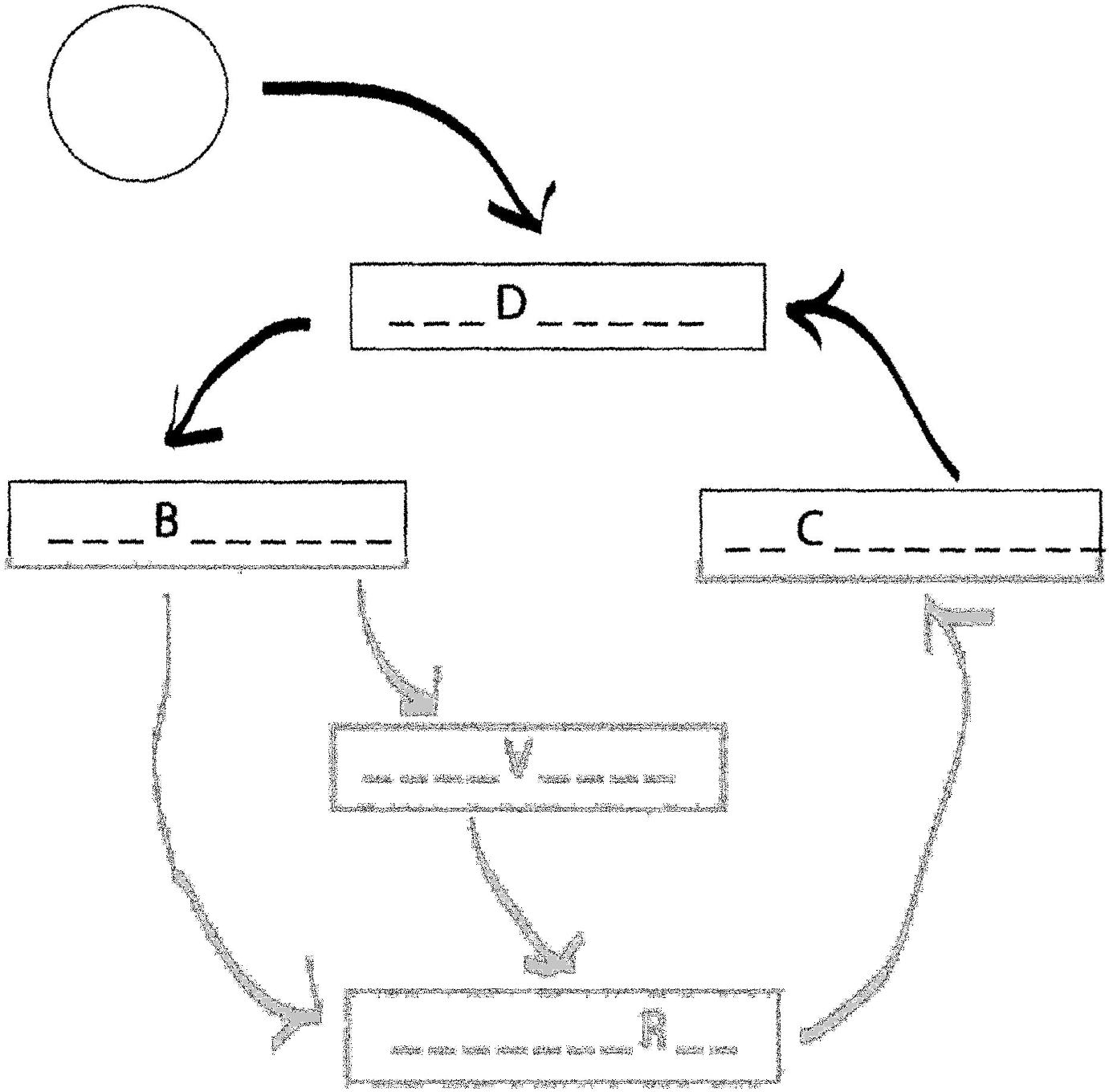
After the game:
1. Assemble the students together.
2. Ask the following and allow the students to discuss:
    - Who has the most cards? (Most often it will be a Mule Deer)

- Does this mean that he/she was the best hunter?
- Why do you think he/she was able to get the most food? (explain that a Mule Deer is a generalist-they have a lot more options for food. If a Mule Deer doesn't get the most cards, it will most likely be one that eats more than one type of food)
- Is it easy to be a carnivore? (It is a lot harder to find food)
- Ask any other questions you think may pertain.

3. Some students may not get any cards at all. Explain that resources are limited and there are some animals that can't always find food. Animals always reproduce more than can survive. If they didn't find food, they were probably just unlucky. Explain that there are no losers in this game. It's just the circle of life.
4. After the discussion, if there is time, try playing the game again and give the students different animals. See if the outcome is the same.

WHERE DO I BELONG ON THE FOOD CHAIN?

Food chain member	What they eat	Clues	Examples
Carnivores	Animals	Sharp teeth Sharp claws Good sense of smell Small, hooked beaks	Mountain lion Bobcat Turkey vulture Raccoon Salmon Owl
Decomposers	Dead plants and animals to create new soil.	Usually live in or near the ground.	Banana slug Worms Bacteria Mushrooms
Herbivores	Plants	Flat teeth Often have hooves Good hearing Large, hooked beaks	Mule deer Chipmunk Squirrel Wood rat Cows Parrot
Omnivores	Plants and animals	Flat and sharp teeth 5 senses work well	Human Chimpanzees Bears Winter wrens
Producers	Makes its own food by using sunlight.	Leaves Stems Trunks Nuts Seeds Fruit Cones Flowers	Redwood trees Redwood sorrel Poison oak Moss Ferns Some bacteria

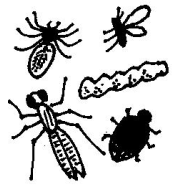
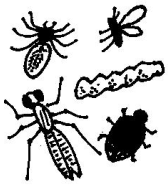
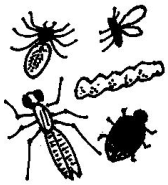
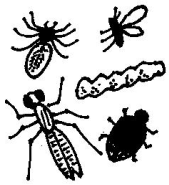
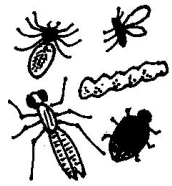
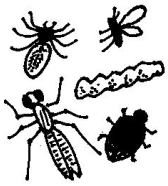
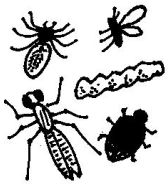
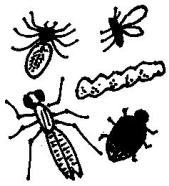
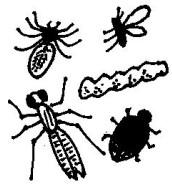
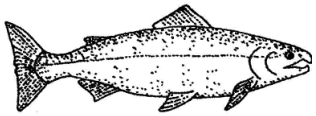
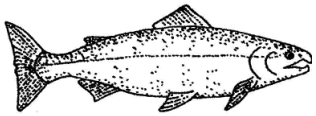
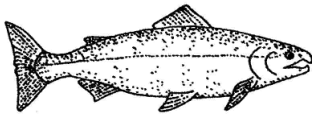
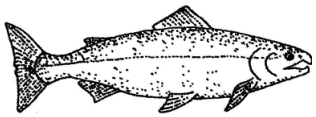
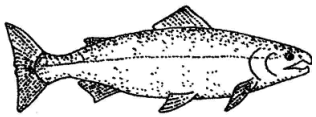

D
B
C
V
R

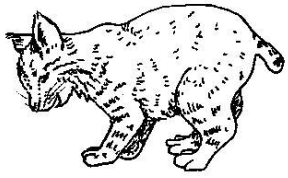
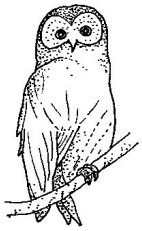
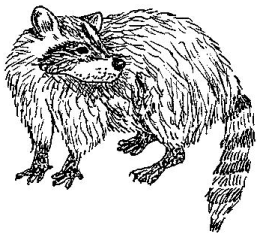
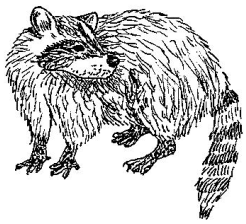
 **SWORD FERN**	 **SWORD FERN**	 **SWORD FERN**	 **SWORD FERN**
 **SWORD FERN**	 **SWORD FERN**	 **SWORD FERN**	 **SWORD FERN**
 **SWORD FERN**	 **SWORD FERN**	 **LADY FERN**	 **LADY FERN**
 **LADY FERN**	 **LADY FERN**	 **LADY FERN**	 **LADY FERN**
 **LADY FERN**	 **LADY FERN**	 **LADY FERN**	 **LADY FERN**

 **TANOAK**	 **TANOAK**	 **TANOAK**	 **TANOAK**
 **TANOAK**	 **TANOAK**	 **TANOAK**	 **TANOAK**
 **TANOAK**	 **TANOAK**	 **REDWOOD SORREL**	 **REDWOOD SORREL**
 **REDWOOD SORREL**	 **REDWOOD SORREL**	 **REDWOOD SORREL**	 **REDWOOD SORREL**
 **REDWOOD SORREL**	 **REDWOOD SORREL**	 **REDWOOD SORREL**	 **REDWOOD SORREL**

 **BAY LAUREL**	 **BAY LAUREL**	 **BAY LAUREL**	 **BAY LAUREL**
 **BAY LAUREL**	 **BAY LAUREL**	 **BAY LAUREL**	 **BAY LAUREL**
 **POISON OAK**	 **POISON OAK**	 **POISON OAK**	 **POISON OAK**
 **POISON OAK**	 **POISON OAK**	 **POISON OAK**	 **POISON OAK**
 **STINGING NETTLE**	 **STINGING NETTLE**	 **STINGING NETTLE**	 **STINGING NETTLE**

			
STINGING NETTLE	**STINGING NETTLE**	**STINGING NETTLE**	**STINGING NETTLE**
			
HORSETAIL	**HORSETAIL**	**HORSETAIL**	**HORSETAIL**
			
HORSETAIL	**HORSETAIL**	**HORSETAIL**	**HORSETAIL**
			
CHIPMUNK	**CHIPMUNK**	**CHIPMUNK**	**CHIPMUNK**
			
CHIPMUNK	**MULE DEER**	**MULE DEER**	**MULE DEER**

 **INSECTS, SPIDERS**	 **INSECTS, SPIDERS**	 **INSECTS, SPIDERS**	 **INSECTS, SPIDERS**
 **INSECTS, SPIDERS**	 **INSECTS, SPIDERS**	 **INSECTS, SPIDERS**	 **INSECTS, SPIDERS**
 **INSECTS, SPIDERS**	 **COHO SALMON**	 **COHO SALMON**	 **COHO SALMON**
 **COHO SALMON**	 **COHO SALMON**	 **STELLER'S JAY**	 **STELLER'S JAY**
 **STELLER'S JAY**	 **WINTER WREN**	 **WINTER WREN**	 **WINTER WREN**

 **BOBCAT loves to eat:** **MULE DEER** **CHIPMUNK** **COHO SALMON**	 **BOBCAT loves to eat:** **MULE DEER** **CHIPMUNK** **COHO SALMON**	 **BOBCAT loves to eat:** **MULE DEER** **CHIPMUNK** **COHO SALMON**
 **BOBCAT loves to eat:** **MULE DEER** **CHIPMUNK** **COHO SALMON**	 **SPOTTED OWL loves to eat:** **CHIPMUNK** **WINTER WREN** **STELLER'S JAY**	 **SPOTTED OWL loves to eat:** **CHIPMUNK** **WINTER WREN** **STELLER'S JAY**
 **SPOTTED OWL loves to eat:** **CHIPMUNK** **WINTER WREN** **STELLER'S JAY**	 **SPOTTED OWL loves to eat:** **CHIPMUNK** **WINTER WREN** **STELLER'S JAY**	 **RACCOON loves to eat:** **COHO SALMON** **STELLER'S JAY** **WINTER WREN**
 **RACCOON loves to eat:** **COHO SALMON** **STELLER'S JAY** **WINTER WREN**	 **RACCOON loves to eat:** **COHO SALMON** **STELLER'S JAY** **WINTER WREN**	 **RACCOON loves to eat:** **COHO SALMON** **STELLER'S JAY** **WINTER WREN**

MULE DEER **loves to eat:**

SWORD FERN
LADY FERN
POISON OAK
STINGING NETTLE
HORSETAIL

MULE DEER **loves to eat:**

SWORD FERN
LADY FERN
POISON OAK
STINGING NETTLE
HORSETAIL

MULE DEER **loves to eat:**

SWORD FERN
LADY FERN
POISON OAK
STINGING NETTLE
HORSETAIL

MULE DEER **loves to eat:**

SWORD FERN
LADY FERN
POISON OAK
STINGING NETTLE
HORSETAIL

MULE DEER **loves to eat:**

SWORD FERN
LADY FERN
POISON OAK
STINGING NETTLE
HORSETAIL

MULE DEER **loves to eat:**

SWORD FERN
LADY FERN
POISON OAK
STINGING NETTLE
HORSETAIL

MULE DEER **loves to eat:**

SWORD FERN
LADY FERN
POISON OAK
STINGING NETTLE
HORSETAIL

MULE DEER **loves to eat:**

SWORD FERN
LADY FERN
POISON OAK
STINGING NETTLE
HORSETAIL

CHIPMUNK **loves to eat:**

BAY LAUREL
TANOAK
REDWOOD SORREL

CHIPMUNK **loves to eat:**

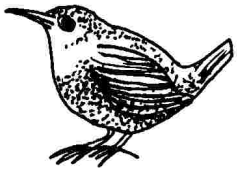
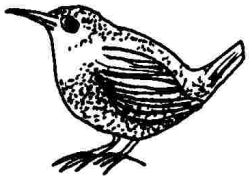
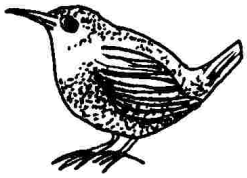
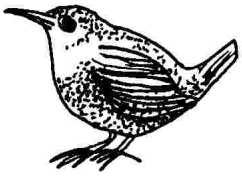
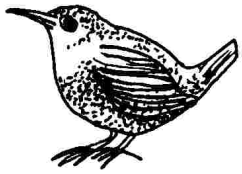
BAY LAUREL
TANOAK
REDWOOD SORREL

CHIPMUNK **loves to eat:**

BAY LAUREL
TANOAK
REDWOOD SORREL

CHIPMUNK **loves to eat:**

BAY LAUREL
TANOAK
REDWOOD SORREL

 **CHIPMUNK loves to eat:** **BAY LAUREL** **TANOAK** **REDWOOD SORREL**	 **STELLER'S JAY** **loves to eat:** **INSECTS, SPIDERS** **TANOAK**	 **STELLER'S JAY** **loves to eat:** **INSECTS, SPIDERS** **TANOAK**
 **STELLER'S JAY** **loves to eat:** **INSECTS, SPIDERS** **TANOAK**	 **STELLER'S JAY** **loves to eat:** **INSECTS, SPIDERS** **TANOAK**	 **STELLER'S JAY** **loves to eat:** **INSECTS, SPIDERS** **TANOAK**
 **WINTER WREN** **loves to eat:** **INSECTS, SPIDERS**	 **WINTER WREN** **loves to eat:** **INSECTS, SPIDERS**	 **WINTER WREN** **loves to eat:** **INSECTS, SPIDERS**
 **WINTER WREN** **loves to eat:** **INSECTS, SPIDERS**	 **WINTER WREN** **loves to eat:** **INSECTS, SPIDERS**	**These 35 cards are to pass out to the students and they get to act as the animal they receive. If your class has less than 35 students, eliminate as many cards as you need to, beginning with one of each animal. (example: if your class has 28 students, take out one of each animal. If your class has 25, take out one of each animal, and three others.)**